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PERFORMANCE ANALYSIS OF 4-S, 2-CC. I ENGINE WITH ROSELLE OIL METHYL ESTERS WITH ADDED IGNITION IMPROVER

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ABSTRACT

In the present work, performance analysis of twin cylinder CI engine is performed. Roselle seed oil methyl esters are extracted from the crude roselle oil by the method of trans-esterification. The tests are conducted in the 4- stroke twin (2) cylinder CI engine and tests were conducted in different stages. Primarily, the tests were performed with4-stroke twin cylinder diesel engine with a diesel fuel and noted down the observations. In the next step, experiments are done on the same engine with different blends of Roselle seed oil like B5, B15, B25 and B35, observations are noted, performance parameters are calculated and emission noted down by using gas analyser.

The results obtained in the second stage are compared to decide which the better blend with diesel fuel parameters is. After Comparison was made between the diesel and bio diesel, optimum blend is selected.

In the next stage, in order to increase the efficiency of the engine ignition, improver is added to the best blend. The tests are conducted on the same engine and same operating conditions, observations are noted and performance parameters calculated and emissions are noted. In the final stage, the obtained parameters with addition of ignition improver are compared with optimum fuel blend

***KEYWORDS:** Alternate Fuel, Roselle Seed Oil, Oil Trans-Esterification & Bio-Diesel*

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Original Article

1. INTRODUCTION

Bio-diesel is nothing but vegetable oil. It is derived from trees or animal fab-based fuel, consisting of long chain alkyl esters. In olden days, wood is the major source of energy which meets the energy demand. Generally, bio diesel is made by lipids, which are chemically reacting with an alcohol production, methyl or ethyl esters. In general, Bio diesel is added with diesel fuel in different proportion or used alone. According to National Biodiesel Board, Bio diesel is a mono-alkyl ester.

Sudhirl et al. analysed about the potential of waste cooking oil (WCO) and compared the fuel properties with fresh oil and base line diesel fuel. They used the method of trans-esterification to produce bio diesel from palm oil methyl ester. Finally, they are telling that performance of pure and fresh palm oil gives better results when compared with waste cooking oil and diesel.

Mathur et al. concentrated to know how much expensive the production and usage of biodiesel by various processess and issues, with use of biodiesel oil in CI engine.

Ilkersugoza et al. conducted different experiments to know the various performance parameters along with emissions of a canola oil methyl esters in1-Ccompression ignition engine. They found that the calorific value of the proposed oil is less. So, the torque and power of the engine are decreased. So, as the power produced is less than the fuel, consumption is also more for the proposed oil. However, exhaust gases were decreased with the use of biodiesel.

VernHofman et. al. performed experiments on four cylinders Cumming CI Engine with sunflower oil with diesel blends. They could do the experiments with pure biodiesel and find that there is 9% of power is decreased when compared with diesel fuel. So, as the power developed in the engine is low, we need to supply more fuel to generate more power, so fuel consumption is more than diesel fuel.

Dutra et al. in their work, they conducted experiments on 1-C diesel engine with palm oil esterification, done by methanol. In this work, they analysed how different properties are influenced with different fuel by measuring the performance parameters of a 1-Ccompression ignition engine. Here, the fuel used is the palm oil methyl ester obtained by trans-esterification process, diesel fuel and its blends with commercial diesel, and its blends with commercial diesel.

2. TRANSESTERIFICATION PROCESS

In the previous years, so many investigations were done in the field of production of alternate fuels, named as bio fuels. The main process to produce bio fuel from the raw oil is trans-esterification process. In this process, the by product is glycerol and main product is bio diesel. The figure below describes the trans-esterification process of Roselle seed oil methyl esters.

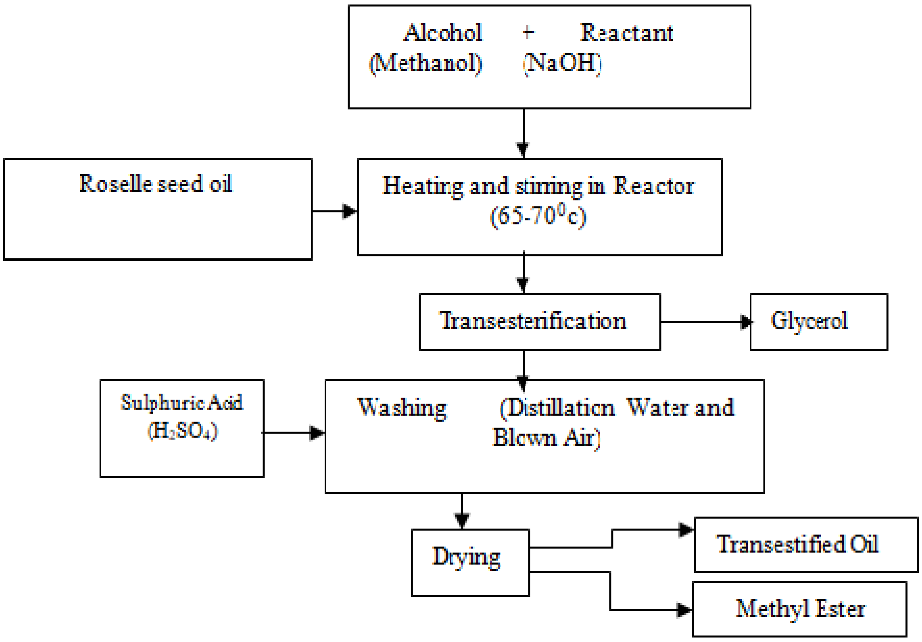

Figure 1: Trans-Esterification Process of Roselle Seed Oil Methyl Esters.

Table 1: Calorific Value of Roselle Seed Oil and Dieselin Kj/Kg

Oïl Name	B100	B30	B20	B10
Transformer oil	41775	42282.5	42318.5	42355
Diesel	42500	42500	42500	42500

Figure 2: Four Stroke Twin Cylinder Diesel Engine.

3. RESULTS AND DISCUSSIONS

3.1 Performance Analysis using Diesel and Roselle Seed Oil Methyl Esters

3.1.1 Brake Thermal Efficiency

The changes in brake thermal efficiency vs load is represented by the figure below. The brake thermal efficiencies at full load condition are 41.31%, 41.91%, 43.20%, 45.46% and 43.97% for the fuels diesel, B05, B15, B25 and B35. Out of the four bio diesel blends, the maximum BTE is 45.46% for B25. The value of increase in BTE is up to 10.06%, as compared with diesel at maximum load.

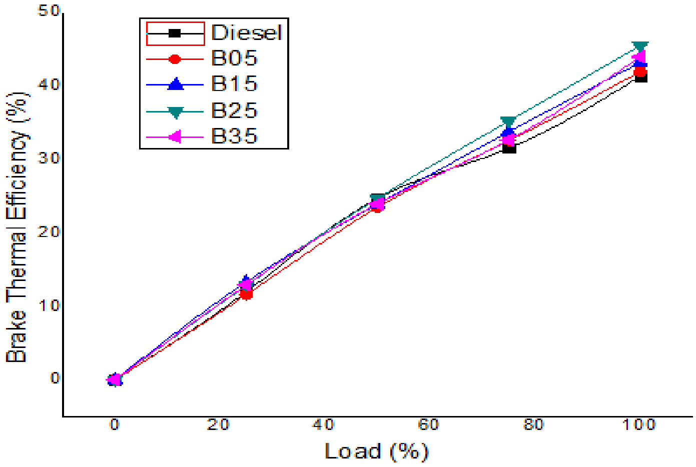

Figure 3: Brake Thermal Efficiency vs Load.

3.1.2 Mechanical Efficiency

The changes of mechanical efficiency vs load is represented in figure. The mechanical efficiencies at maximum load condition obtained are 63.11%, 71.99%, 71.81% , 72.08% and 72.17% for the fuels of diesel and B05, B15, B25 and B35, respectively. From the above results, it is seen that there is considerable change in mechanical efficiency, using blends of roselleseed oil.

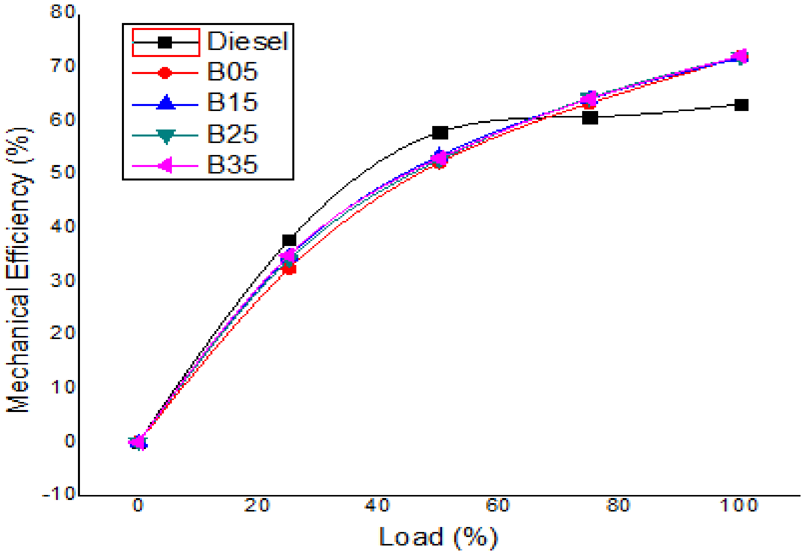

Figure 4: Variation of Load Vs Mechanical Efficiency.

3.1.3 Volumetric Efficiency

Volumetric efficiency vs load is represented in figure below. At maximum load condition, the efficiencies are 69.75%, 67.15%, 67.33%, 67.29% and 67.30% for fuels diesel, B05, B15, B25 and B35.

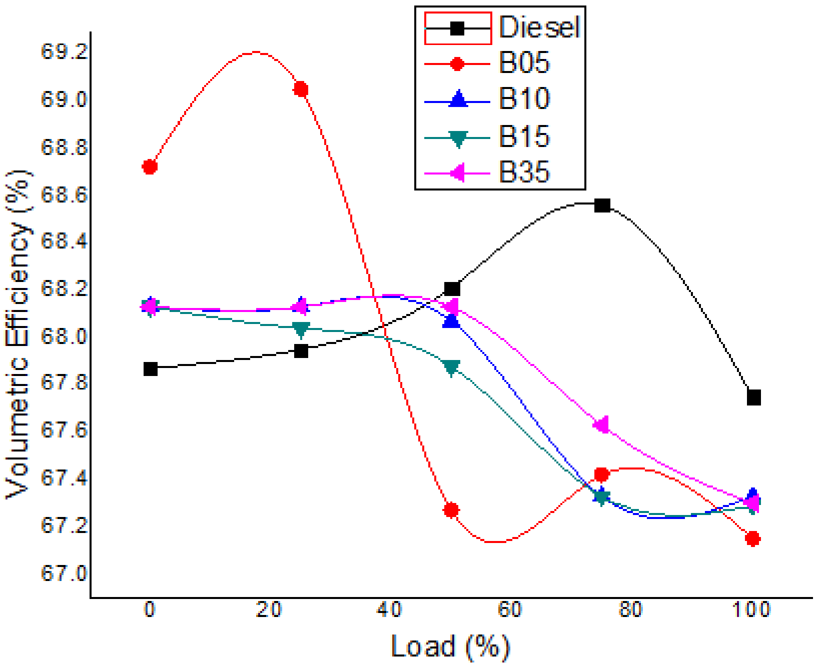

Figure 5: Variation of Load vs Volumetric Efficiency.

3.1.4 BSFC

The changes of BSFC vs load is represented in figure below. At full maximum load, the BSFCs are 0.204 kg/ kW-hr, 0.202 Kg/kW-hr, 0.196 Kg/kW-hr, 0.186Kg/kW-hr and 0.192 kg/kW-hr for fuels diesel, B05, B15, B25 and B35. The lowest fuel consumption for B25 is 0.186 kg/kW-hr, and it is 0.192 kg/kW-hr for diesel.

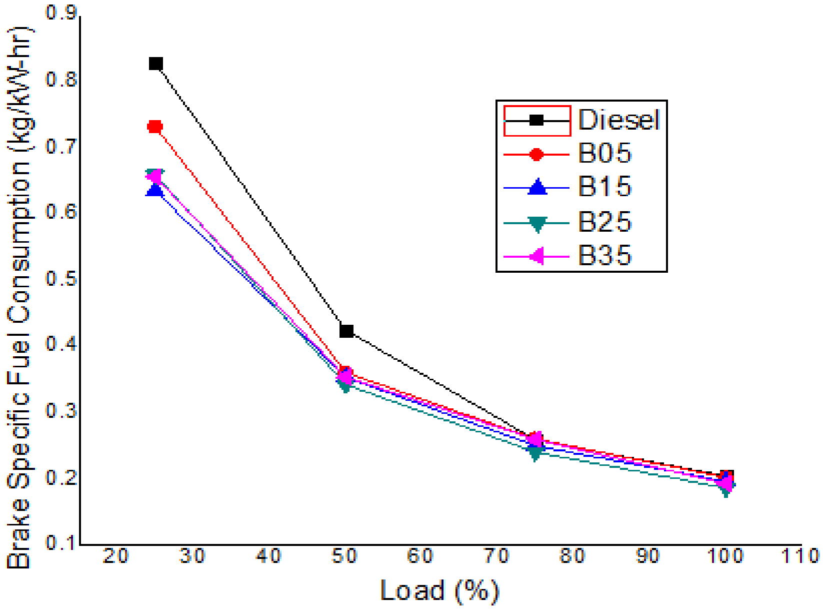

Figure 6: Load vs BSFC

3.1.5 Air-Fuel Ratio

The Air-fuel ratio vs load is represented in figure below. At maximum load, the air-fuel ratio values are 45.53, 38.27, 40.06, 39.85 and 39.97 for the fuels of diesel, B05, B15, B25 and B35. From the graph, it is concluded that A/F ratio decreases up to 31.62% compared with Diesel at maximum load condition of blend (B25).

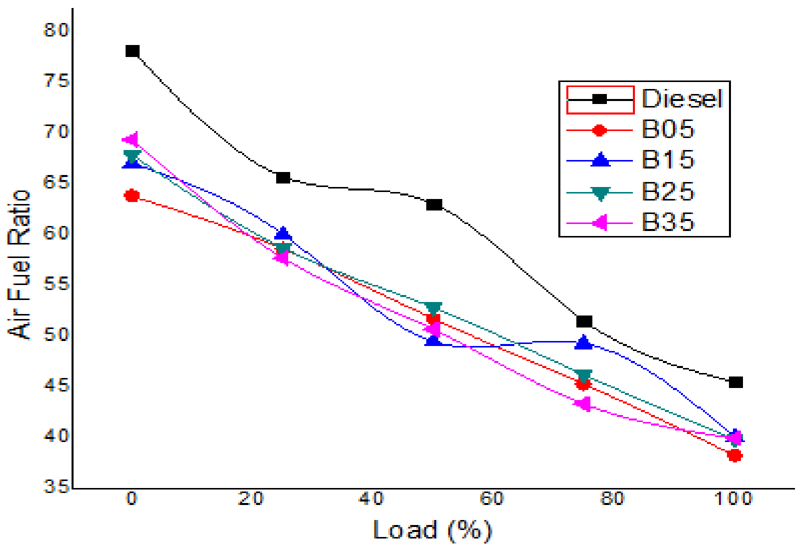

Figure 7: Variation of Load vs Air Fuel Ratio.

3.2 Performance Analysis using B25 Blend with Ignition Improver (Iso PropylAlcohol)

3.2.1 Brake Thermal Efficiency

Brake thermal efficiency vs load is represented in figure. The BTE of diesel at maximum load is 41.31% and for blends of B25 is 45.46%, B25D74ISPA1 is 46.23%, B25D73ISPA2 is 46.00%, out of the three the maximum BTE is

46.23% forB25D74ISPA1. BTE of Roselle seed oil increases by 1.693% as compared with optimum blend at maximum load.

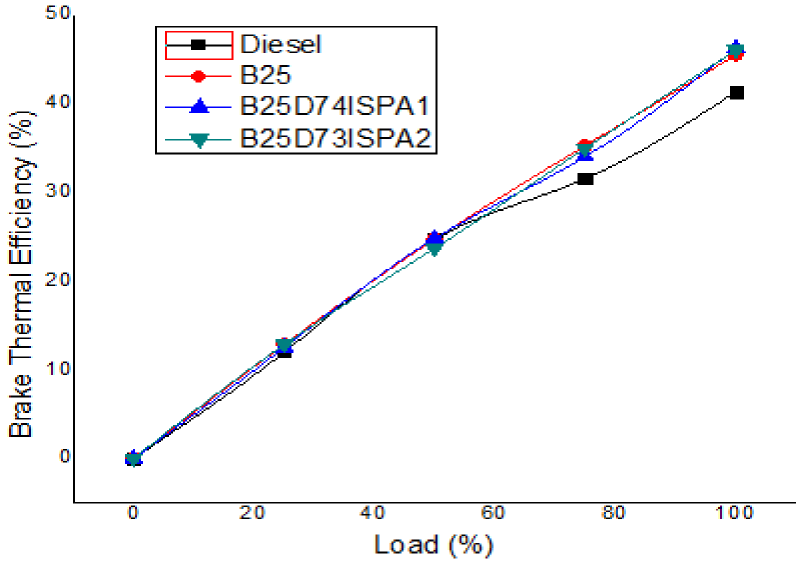

Figure 8: Variation of Load vs Brake Thermal Efficiency with Igniton Improver.

3.2.2 Mechanical Efficiency

Mechanical efficiency vs load is represented in figure below. At maximum load, mechanical efficiencies are 63.11%, 72.08%, 71.69% and 71.95% for fuels of diesel and B25, B25D74ISPA1and B25D73ISPA2, respectively. From the above results, it is concluded that there is considerable variation in mechanical efficiency, using blends of roselle seed oil.

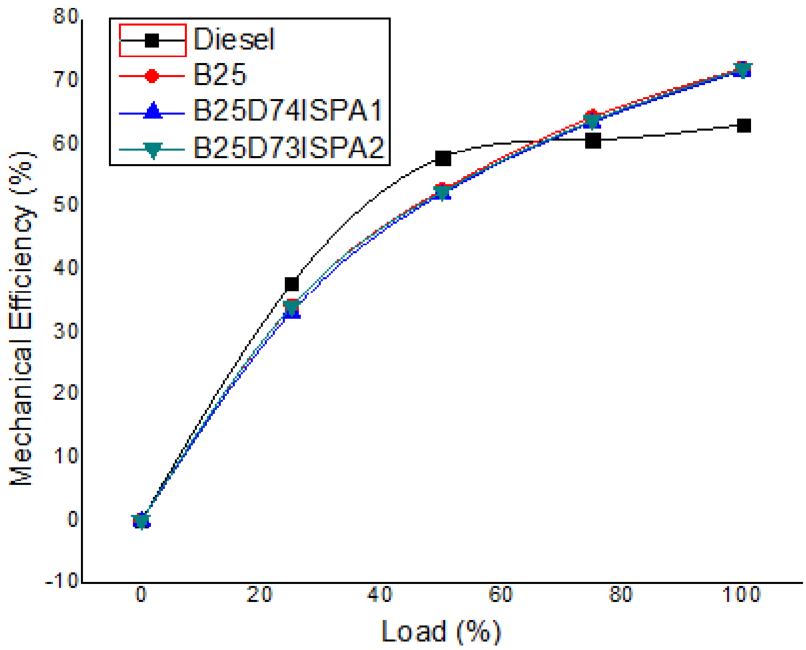

Figure 9: Variation of Load vs Mechanical Efficiency with Igniton Improver

3.2.3 Volumetric Efficiency

Volumetric efficiency vs load is represented in figure. At maximum load, efficiencies are 69.75%, 67.29%, 67.29% and 67.88% for the diesel and B25, B25D74ISPA1and B25D73ISPA2, respectively. The reduction of volumetric efficiency is considerable for using blends of roselleseed oil.

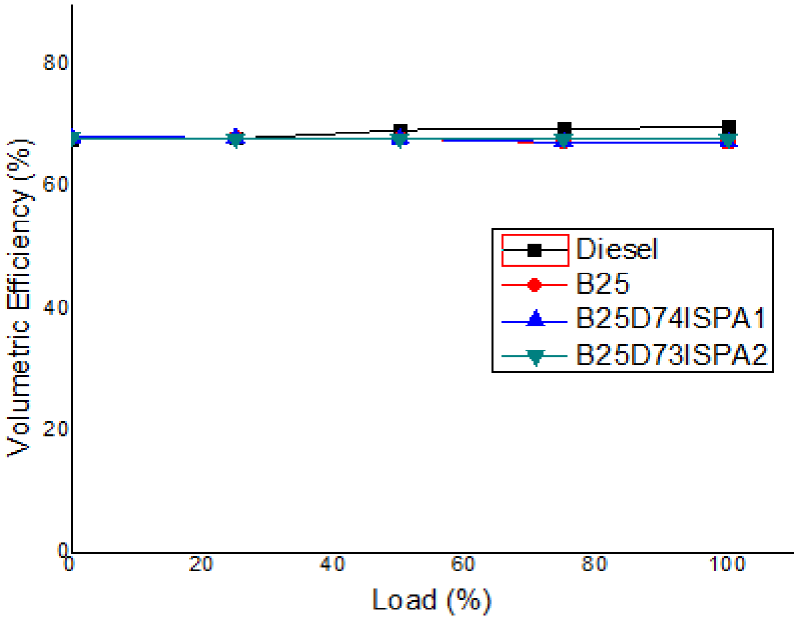

Figure 10: Variation of Load vs Volumetric Efficiency with Igniton Improver.

3.2.4 BSFC

The changes of bsfc vs load is represented in figure below. At maximum load, BSFCs are 0.204, 0.1863, 0.1832 and 0.1841 kg/kW-hr for diesel, B25, B25D74ISPA1and B25D73ISPA2. From the figure, it is concluded that BSFC decreases by 1.98%, after addition of ignition improver than B25.

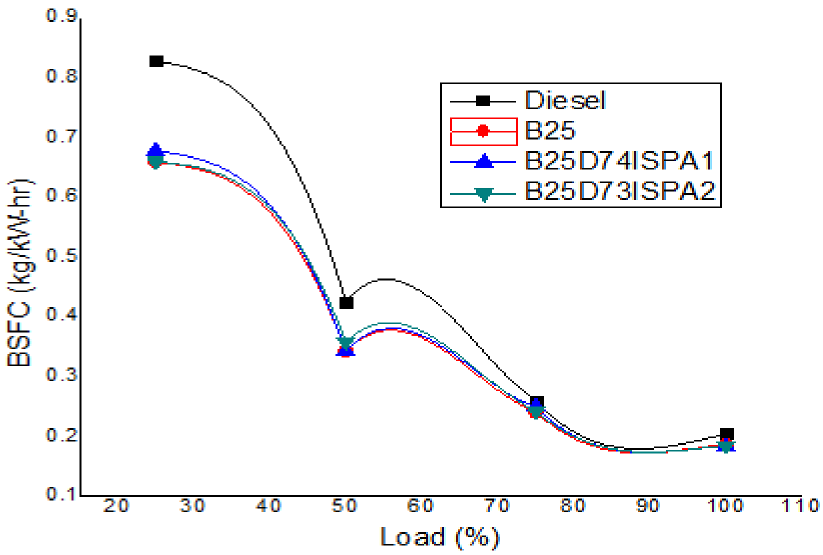

Figure 11: Variation of Load vs Brake specific Fuel with Igniton Improver.

3.2.5 Air-Fuel Ratio

Air-fuel ratio vs load is represented in figure below. From the plot, it is found that A/F ratios are 45.53, 39.85, 43.03 and 42.74 for diesel, B25, B25D74ISPA1and B25D73ISPA2, respectively.

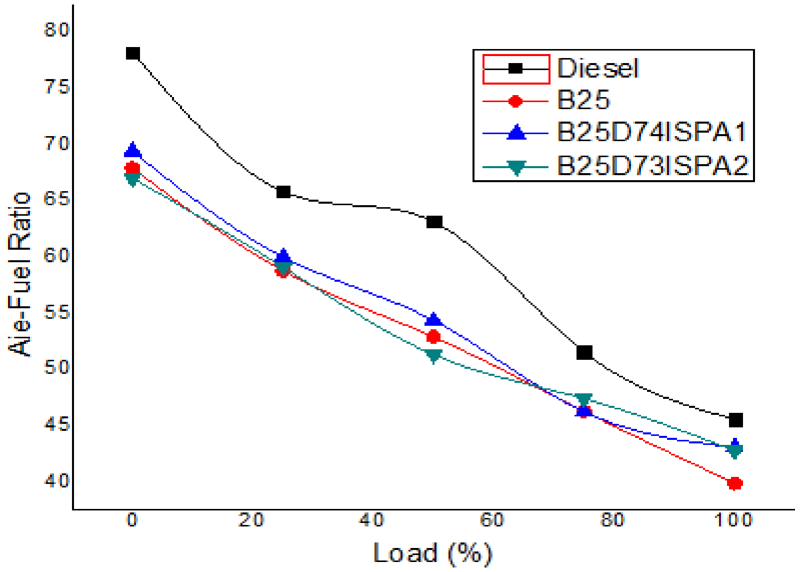

Figure 12: Variation of Load vs Air-Fuel Ratio with Igniton Improver.

4. CONCLUSIONS

- The performance analysis was done on 4-stroke twin cylinder CI Engine. In first stage, the optimum blend is found by comparaing the results obtained when doing experiments with diesel fuel parameters.
- From the results, it is found that B25 gives the better results than the diesel fuel.
- In the next stage, experiments are conducted with blend B25 with ignition improver isopropylalcohol in the quantity of 1% (B25D74ISPA1) and 2% (B25D73ISPA2), B25D74ISPA1has given the better performance.
- The BTE at maximum load for diesel is 44.08%, for B25is 45.46%, B25D74ISPA1is 46.23%, B25D73ISPA2 is 46.00%. Among the three, the maximum BTE is 46.23% which is obtained for B25D74ISPA1. The BTE of roselle seedoil is increases by 1.693% as compared with B25.
- At maximum load condition, the BSFC are 0.1923, 0.1863, 0.1832 and 0.1841 kg/kW-hr for diesel, B25, B25D74ISPA1 and B25D73ISPA2, respectively. It is concluded that BSFC decreases by 1.98% after addition of ignition improver than B25.
- From all the discussions, we say that the Roselleseed oil can be used as an bio fuel in the CI engines with the addition of ignition improver in isopropylalcohol, operating without any modifications of engine.

REFERENCES

1. *Sudhirl et al , Comparision of properties of a compression ignition engine operating on diesel-biodiesel blend with methanol additive Fuel (waste cooking oil) 2016;170;245–53*
2. *Mathur Y. B., Poonia M. P. and Jethoo A. S., "Economics, Formulation Techniques and Properties of Biodiesel A Review" Universal Journal of Environmental Research and technology, Volume1, 2011, Issue 2: 124–134.*

3. *Ilkersugözüacengizönera and Şehmusaltunb, "The Performance and Emissions Characteristics of a Diesel Engine Fueled with Biodiesel and Diesel Fuel" Int. Jornal of . Engineering Research Development, Vol.2, No.1, January 2010.*

4. *Vern Hofman and Elton Solseng "Biodiesel Fuel Use in an Unmodified Diesel Engine". An ASAE /CSAE Meeting Presentation, Paper No: MBSK 02–109.*

5. *Dutra, Teixeira, Colaco, Alves, Caldeira and Leiroz, "Comparative Analysis of Performance and Emissions of an Engine Operating with Palm Oil Mmmethyl and Methyl esters and Their Blends with Diesel", 20th International congress of Mechanical Engineering, Gramado, RS, Brazil November 15–20, 2009.*

6. *Ch. Naveen kumar et. al. Experimental Investigation on 4-Stroke Single Cylinder Diesel Engine by Using Roselle Seed oil as Bio-Diesel", IJETT, ISSN: 2231–5381, Volume-43 Number-3 -January 2017, Pages 173–178.*

7. *BP statistical review of world energy. 64th edition June 2015. https://www.bp.com/content/dam/bp/pdf/energy-economics/statistical-review-2015/bpstatistical-review-of-world-energy-2015-full-report.pdf.*

8. *News article: 80 per cent of world's city dwellers breathing bad air: WHO. The Economic Times; May 12, 2016. http://articles.economictimes.indiatimes. com/2016-05-12/news/73039618_1_air-quality-maria-neira-air-pollution.*

9. *Rao, N. D. P., Krishna, M. M., Prasad, B. A., & Murthy, P. The effect of thermal barrier coating on exhaust emissions and combustion characteristics of diesel engine with rice brawn oil based biodiesel. International Journal of Research in Engineering and Technology, ISSN (E), 2321–8843.*

10. *News article: air pollution growing in India, China: NASA. The Economic Times; Dec 15, 2015. http://articles.economictimes.indiatimes.com/2015-12- 15/news/69062104_1_air-quality-air-pollution-nitrogen-dioxide.*

11. *Armas Octavio, Gomez Arantzazu, Ramos Angel. Comparative study of pollutant emissions from engine starting with animal fat biodiesel and GTL fuels. Fuel 2013;113: 560e70. http://dx.doi.org/10.1016/j.fuel.2013.06.010.*

12. *Barrios Carmen C, Domínguez-Saez Aida, Martín Carlos, Alvarez Paloma. Effects of animal fat based biodiesel on a TDI diesel engine performance, combustion characteristics and particle number and size distribution emissions. Fuel 2014;117:618e23. http://dx.doi.org/10.1016/j.fuel.2013.09.037.*

13. *Umesh, K., Pravin, V., & Rajagopal, K. An Approach (Performance Score) for Experimental Analysis of Exhaust Manifold of Multi-Cylinder SI Engine to Determine Optimum Geometry for Recreational and Commercial Vehicles.*

14. *Alpteki Ertan, Canakci Mustafa, Ozsezen Ahmet Necati, Turkcan Ali, Sanli Huseyin. Using waste animal fat based biodieselsebioethanoldiesel fuel blends in a DI diesel engine. Fuel 2015; 157:245e54. http://dx.doi.org/10.1016/j.fuel.2015.04.067.*

15. *Umesh, K. S., Pravin, V. K., & Rajagopal, K. (2014). Experimental Investigation and CFD Analysis of Multi-Cylinder Four Stroke SI Engine Exhaust Manifold for Optimal Geometry to Reduce Back Pressure and to Improve Fuel Efficiency. International Journal of Automobile Engineering Research and Development, 4, 13–20.*